

Available online at www.sciencedirect.com**ScienceDirect**

Procedia Computer Science 27 (2014) 113 – 122

Procedia
Computer Science

5th International Conference on Software Development and Technologies for Enhancing
Accessibility and Fighting Info-exclusion, DSAI 2013

Promoting IPTV accessibility for visually impaired users: implementation of an adapted service

Rita Oliveira^{a*}, Jorge Ferraz de Abreu^a, Ana Margarida Almeida^a

^aDepartment of Communication and Arts - CETAC.MEDIA, University of Aveiro, 3810-193 Aveiro, Portugal

Abstract

In spite of the wide dissemination of technologies and digital resources, people with special needs still find barriers and difficulties in accessing and using many of the information technology (IT) services currently available. This problem is particularly critical in usage scenarios involving mass media devices like Television (TV), specially taking in consideration its interactive format with all advanced features it brings. In this context, the creation of inclusion strategies becomes essential for increasing digital literacy and citizens' capacity to participate in different areas using advanced services like Interactive Television (iTV). Universal Design shows up as the appropriate approach to answer this problem, since the systems that are shaped based on this methodology make available the accommodation of a wide range of human skills, abilities, needs and preferences.

In this framework, this paper introduces a research related to universal design issues on the iTV scope, which aims the conceptualization, prototyping and validation of an IPTV service specifically designed to look on visually impaired users' needs. The presented results are based on the second phase of this research, which intended the conceptualization and development of the prototype. Accordingly, we describe the elicitation process of the technical and functional requirements that led us to the implementation and test of the advanced and customizable features of an adapted IPTV service.

© 2013 The Authors. Published by Elsevier B.V. Open access under [CC BY-NC-ND license](http://creativecommons.org/licenses/by-nc-nd/3.0/).

Selection and peer-review under responsibility of the Scientific Programme Committee of the 5th International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-exclusion (DSAI 2013).

Keywords: Visual Impairment; Interactive Television; Universal Design, IPTV

* Corresponding author. Tel.: +351-234-370-389; fax: +351-234-370-868.

E-mail address: ritaoliveira@ua.pt

1. Introduction

In spite of the upgrades performed on TV services adapted to visually impaired users in some countries, they may still be subject to a set of improvements in order to meet the needs of this type of users in a more efficient way. At the same time, the current infrastructures of television distribution have technological potentialities that offer attractive opportunities for the implementation of adapted TV services with advanced features. In order to avoid the social exclusion of visually impaired people in accessing digital TV, which plays a central role as a source of information and entertainment services (video on demand, games and other interactive applications), several interaction problems need to be solved [1].

In Portugal, the current situation concerning the relationship between users with visual impairments and the television demands more effort in this research field, since there are a significant number of people with this type of impairment who do not benefit entirely from the capabilities of the current TV paradigm. According to the 2011 Portuguese Census, 9.3% of the population over 5 years old (about 921,000 people) is visually impaired, 97% of them (about 893 000) have great difficulty in seeing and the remaining 3% (about 28,000) are blind [2]. However, in what concerns the accessibility of television contents, this considerable number of citizens can only follow the emission of a small part of the TV programming through audio description (AD), namely in RTP1[3]. In addition to the insignificant number of TV programs with audio description that are broadcasted [4] (about once a week, sometimes in a discontinuous way), this feature is still analogue and broadcasted by radio signal. Regarding the advanced features brought by iTV services, they usually rely on user interfaces with a high visual component (it is necessary to read instructions on the screen and select options with the remote control), so visually impaired users experience many difficulties and may even be unable to access such services.

In what concerns to the IPTV solutions available in Portugal none provides an audio description service. In this context, three main reasons encouraged us to enhance this pay-TV service: i) IPTV is having a very high penetration rate (even among customers that already were prevented to receive free-to-air TV due to the analogue switch-off); ii) IPTV is a promising technical infrastructure to improve the visually impaired users' accessibility on TV; and iii) it can provide other services targeted to users with special needs.

This paper begins by presenting the related work to our research, followed by a complete explanation of the conceptualization process of the prototype, pointing out its technical and functional requirements as well as the features that compose it.

2. Related Work

In this section, some examples of TV adapted services target to visually impaired users are covered, namely various solutions existent in the United Kingdom market (where there is a strong investment in this area) and also in Portugal and Spain. This analysis was especially useful to our work considering that some features of these services were used as a reference in the development of the proposed prototype.

2.1. ZON Audio Description

At December of 2004, the audio description service on ZON (a Portuguese Cable TV provider) was released in a partnership with 'Lusomundo' channels (currently 'TVCine') [5]. This was the first (and the only until today) service focused on people with visual impairment broadcasted by a digital television provider in Portugal. The ZON's audio description process consists of a digital additional narration to the soundtrack of the audiovisual narrative, as is the case in most digital TV services of audio description.

To access this service, ZON customers should press the green button of the set-top box (STB) remote control and press "OK" on "Áudio Descrição" ("Audio Description") option [6]. To return to see the program without audio description, the user should select the "Sem áudio descrição" ("No audio description") option that is present on the screen and press "OK". Since no additional information is provided, visually impaired users need to be helped in order to interact with this service.

In 2010, ZON already had over one hundred and eighty movie exhibitions with audio description (about 2-3 movies exhibitions per month since 2004).

2.2. Sky Audio Description

The British satellite broadcasting company 'Sky' provides an audio description service for its users [7]. The subscribers of this solution can access the list of all programs with audio description for the next 7 days on the 'Sky' website or, alternatively, they can contact the company by postal mail or e-mail to require that list.

In order to know when a program has audio description, users need to activate the 'Audio Narrative Beep' option. This option triggers a warning sound when a program with audio description starts, enabling visually impaired customers to clearly identify when an audio description track is available on the TV program. 'Sky' customers can also set up the audio description option permanently or temporarily, however to perform this action users need to go through multiple screens and select various options and the steps that must be follow are different from STB to STB.

2.3. Smart Talks

The 'Smart Talks' is a TV STB that announces all on-screen information, including program guides and menus, using speech synthesis [8]. It was designed and developed in conjunction with The Royal National Institute of Blind People (RNIB) Lab to provide full access to Freeview (a British company that provides free-to-air digital TV channels) to blind and partially sighted people. Users with this STB can know that a TV program with audio description is being broadcasted when the word 'AD' is displayed over the program information window. In addition, users can listen the information about the program they are watching by pressing the 'info' button on the remote control. Another way to access the information of a particular program is through the program information window, pressing the 'info' button on the desired channel.

The audio description function is not 'on' by default; hence, to set up this option users have to press the AD button on the remote control [9]. Besides this option, users can also access to preferences related to the activation of audio description (Fig. 1).

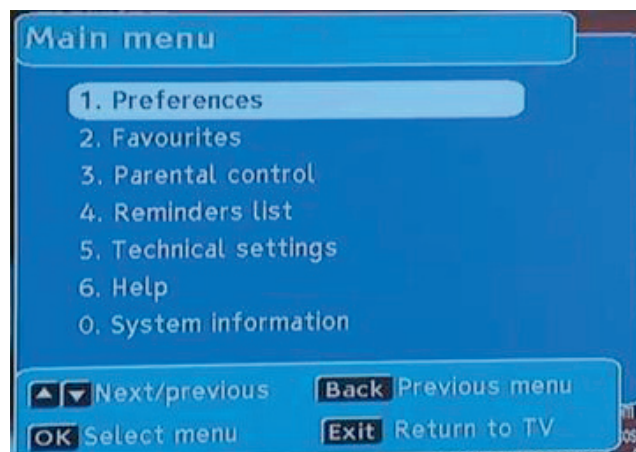


Fig. 1. Smart talks main menu [10]

2.4. Sky Talker

The ‘Sky Talker’ STB is dedicated to the satellite TV broadcast and, similarly to the ‘Smart Talks’, it processes the automatic reading of the textual information that appears on the screen [11]. The ‘Sky Talker’ narrates the search area, the programs synopsis and the TV content control functionalities (play, pause, forward and rewind). The new device is compatible with existing boxes, enabling customers not have to use a new interface.

2.5. IDTVOS

The STB ‘IDTVOS’ [12] was designed and developed in Spain and was conceived taking into account the needs of visually impaired users; however it has not yet been launched. All the equipment can be controlled by voice and in its system are included features that control color contrast and font size, enabling the modification of the appearance of menus and Electronic Programming Guide (EPG). The device is available in two versions (SD and HD) and both have recording functions and conditional access services. Furthermore, through the HD equipment the user can access audio description and has access to a virtual remote control (via Internet) that can help users with physical disabilities.

2.6. iPlayer

BBC provides the ‘iPlayer’ service [13] (a TV and Radio streaming service of BBC) that can be accessed through different devices. Programs are usually available on the service during seven days after the broadcasting on TV. Besides that, the service includes videos of programs with audio description, subtitles and sign languages, however only for PC. To have access to this content user needs to navigate to the iPlayer website (<http://www.bbc.co.uk/iplayer/>) and choose one of two options: i) view the content directly on the website or ii) download the iPlayer application to his personal device to play downloaded content (where are available for 30 days).

3. Research Process

The research process of the work described in this paper was structured in three phases. In the first phase (functional requirements elicitation) the difficulties and needs of visually impaired users as consumers of television content and iTV services were identified. The second phase is related with the implementation of an adapted interactive IPTV service that followed universal design principles and includes adapted features to visually impaired users. Finally, the third phase encompasses the testing and evaluation, carried out by a group of visually impaired users, of the prototype.

The first phase was based on the Grounded Theory [14] in order to obtain significant and sufficient data to: i) determine the difficulties and needs of visually impaired users as consumers of television contents (on a first stage – see 3.1. First Phase (1st stage)); and ii) gather their opinions as users of the free public Portuguese audio description service (on a second stage – see 3.2. First Phase (2nd stage)). In the next section we describe briefly the results obtained in this phase that enabled the conceptualization of the prototyped IPTV adapted service.

3.1. First Phase (1st stage)

In this stage a group of individuals was asked to participate in an interview. They were selected arbitrarily, with the help of an ophthalmologist, from patients at the low vision appointment of the ‘Instituto de Oftalmologia Dr. Gama Pinto’ [15] in Lisbon, with the help of an ophthalmologist. In total, 20 subjects with visual impairment accepted to be interviewed: 10 of which were blind and the remaining 10 had low vision. The main outcomes of this phase was obtained when the interviewees spoke about their difficulties as consumers of television content and how they believed these problems could be solved. These solutions are depicted in Fig.2.

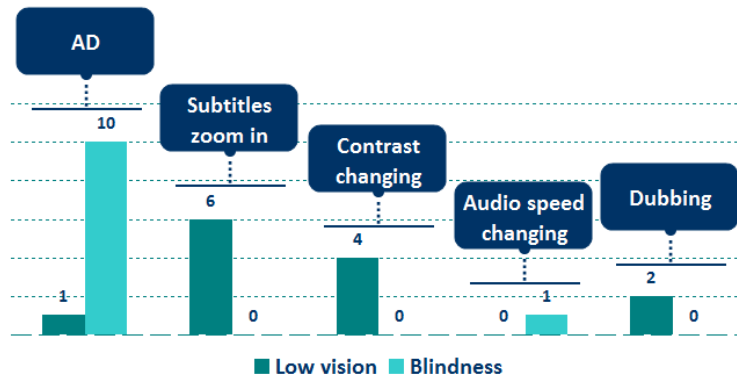


Fig. 2. Solutions given by interviewees to the problems they experience when they watch TV

3.2. First Phase (2nd stage)

In this stage a group of 6 participants was organized aiming the evaluation of the Portuguese public audio description service. All individuals had visual impairment (4 were blind and the other 2 had severe low vision) and had already integrated the previous research stage. The main outcomes of this stage were obtained when the interviewer asked the subjects about their difficulties and needs as users of the Portuguese free public audio description service. After that, it was proposed that the subjects give suggestions to improve the system. These suggestions are depicted in Fig. 3.

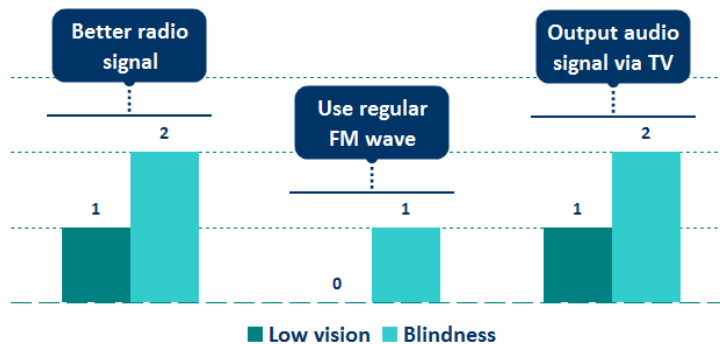


Fig. 3. Suggestions given by the participants to improve the service

4. Prototype

The selected findings from the first research phase, as well as a literature review that was carried out (concerning user interface design principles for iTV applications addressed to this target audience), enabled the conceptualization of an IPTV adapted service and its prototyping based on a set of technical and functional requirements. In the next sections these requirements and the prototyped features are described.

4.1. Technical Requirements

The prototype runs over the main IPTV commercial infrastructure in Portugal, which is based on 'Microsoft Mediaroom PF'. In technical terms, the prototype is developed using the programming language 'C Sharp' ('C#'),

compiled in the Integrated Development Environment 'Microsoft Visual Studio' through the '.Net framework'; and runs in an application server enabling it to be accessed via an IPTV STB (Fig. 4.).

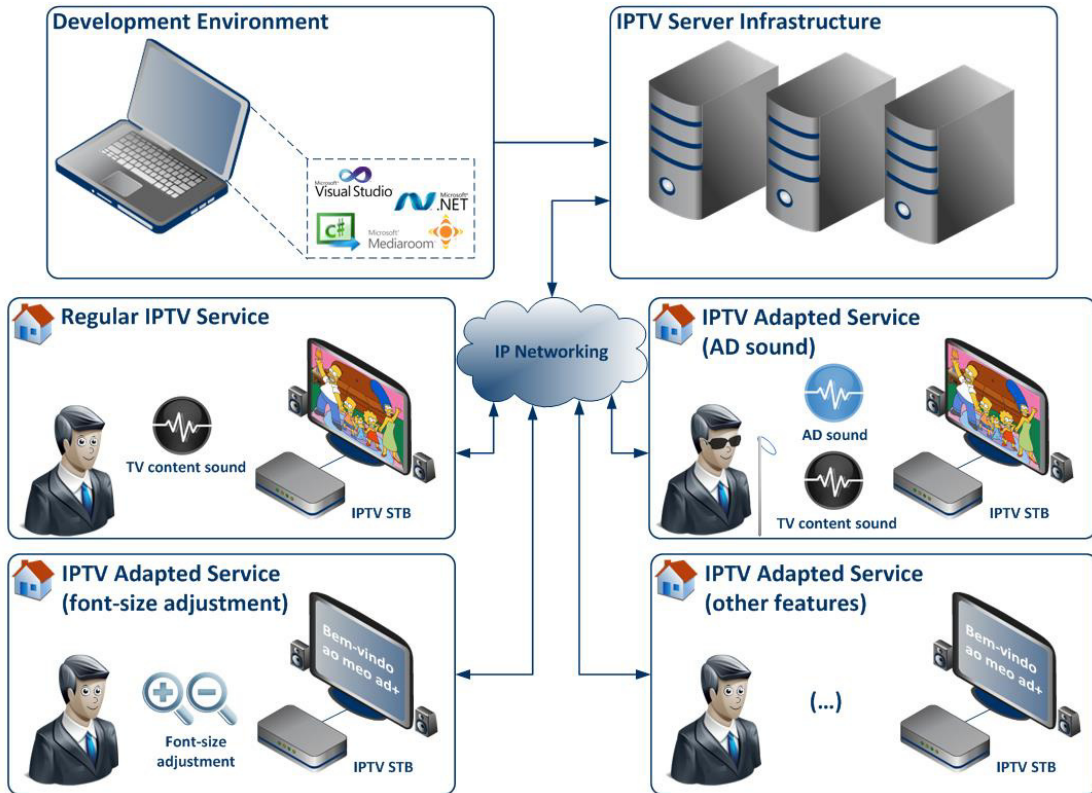


Fig. 4. System architecture of the prototype

4.2. Functional Requirements

- **Audio Description**
The user must have access to audio descriptions of audiovisual narratives - movies, series, etc. (previously provided by the TV provider), synchronized with the television content.
- **Audio Description Customization**
The user must be able to choose the narrator's audio description voice (e.g.: female or male voice), the language (among those available in the TV program) as well as to control the volume and speech speed.
- **EPG Personalization**
The system must be able to identify and filter programs with audio description on the EPG. As a result, the system must grant the user the possibility to choose what he wants to see from a list that includes all his favorite channels and programs.
- **Visual Adaptability/Accessibility**
The system must give the user the choice to perform image and font-size magnification of its menus and television content. In addition, it is important to have the option to adjust brightness and contrast of the menus.

- Audio Feedback and Help

The system audio feedback must be triggered when the user accesses the menu options or when he selects any menu item. It is also valuable to have audio feedback when a program with audio description starts or when a regular program of interest to user is going to start. In addition, it is important that contextual help option be always present and accessed by a hotkey, providing audio information about where the user is, what it can do and how to leave the menu/screen.

- User Automatic Identification

The system must be able to identify the user automatically. Consequently, when the user is identified, his preferences must be loaded and the system must be adjusted to them.

4.3. Prototyped Features

The functional requirements of the prototype go beyond a regular service adapted to visually impaired users since it was our goal to enhance the user interface and the global user experience easing the interaction with the STB system. Due to technical and temporal issues, it was not possible to fully implement all the features, although the remaining ones are simulated in the prototype, so the user can have a general idea of the concept.

4.3.1. Implemented Features

- Audio description warning sounds (to enable users to know when a program with audio description starts);
- Audio description (supported by a digital soundtrack);
- Adjustment of audio description volume (independently of the original soundtrack);
- Audio feedback (when user accesses menu options/items);
- Contextual help (always present and accessed by a hotkey);
- Font-size menus adjustment (both zoom in and zoom out);
- Selection of color schemes (Fig. 5.).



Fig. 5. Color scheme feature: one of the implemented features

4.3.2. *Simulated Features*

- Audio description textual display on EPG;
- Selection of audio description voice (male or female);
- Subtitles' size adjustment (both zoom in and zoom out);
- Subtitles' reading (through a text-to-speech system);
- Favorite subtitled and audio described programs (a list created by the user);
- Automatic user identification (the system adjusts itself to the user preferences).

4.3.3. *Other Features*

Despite the proposed features of the prototype, we sorted out some improvements that could enhance other features of the IPTV service for this type of users.

- Play audio feedback when the user:
 - Press UP/DOWN keys of the remote control (displaying the information of current and next program);
 - Pause TV content;
 - Record TV content.
- Adapted version of the VoD service with an offer of:
 - Audio described and subtitled content (in mother language);
 - Radio stations.

5. **Prototype Evaluation**

Regarding the prototype evaluation, usability and accessibility tests through direct observation of a group of visually impaired users and semi-structured interviews have already been conducted (Fig. 6.).

The sample that integrates this research phase was selected by convenience and composed by 9 users: 4 blind participants, 3 with low vision and 2 colorblind.

Data was collected using an observation guide, structured on a set of foreseen tasks that the participant had to carry out and also on some additional questions. Subsequently, the tasks performed by users will be analyzed using evaluation and performance scales, making possible to collect quantitative data in order to systematize the behavior and actions of the participants. Each subject participated in three test sessions (on different days) in order to collect data concerning their evolution. In order to keep the user motivated across the sessions, some strategies have been used, for instance divide into three parts the movie with audio description that they had to watch.

Additionally, two semi-structured interviews were also applied to these participants: one of the interviews was carried out before beginning the three sessions allowing us to obtain data about the user profile (age, occupation, etc.) and his relationship both with TV and with common Information and Communication Technologies. The second interview was performed at the end of the sessions in order to collect data regarding the participant's satisfaction and general opinion about the service.



Fig.6. A test session with one of the participants

6. Conclusions and Future Work

The info-inclusion of people with disabilities is becoming a reality. However, it is necessary to investigate and develop more services and tools that allow the creation of opportunities that enable all citizens to participate actively and autonomously in society. Over the last years, several research projects were focused on the study of universal access systems, which share the same goals: the importance to consider the specificities of the users and the variety of usage contexts of all groups of users. Our research, centered on a mass media device, underlines these goals as it intends to: i) contribute to the development of universal design strategies in the TV interaction models; and ii) promote the digital inclusion of television consumers with visual impairment using an interactive adapted TV service (although our prototype was made over a commercial IPTV service, it is worth to say that the related features could be applicable to other types of interactive TV).

With the test sessions that were carried out, it was observed that generally all visually impaired persons who participated in the prototype evaluation showed satisfaction with the features offered by the system as well as with its interaction design. In order to validate entirely this fact, we will continue the analysis of the remaining results of the prototype evaluation (to be published soon) aiming to better understand if this service will actually meet the needs of such users. To complement the test sessions performed, a focus group will be conducted with the participation of some persons who integrated the previous evaluation, aiming the exchange of ideas about the service prototyped.

Acknowledgements

Our thanks to: i) Institute of Ophthalmology Dr. Gama Pinto for allowing us to interview its low vision appointment patients; ii) the interviewees of the first research phase and the evaluators of the prototype for their openness and kindness; iii) the coordinators and collaborators of iNeighbour TV Project funded by FEDER (through COMPETE) and National Funding (through FCT) under grant agreement no. PTDC/CCI-COM/100824/2008 for the provision of their IPTV infrastructure.

References

1. eAccess Plus (eAccess+): Accessible Digital TV for the Visually Impaired, eAccess+ Website, 2012. URL: http://hub.eaccessplus.eu/wiki/Accessible_Digital_TV_for_the_Visually_Impaired.
2. Instituto Nacional de Estatística (INE): *Censos - Resultados definitivos : Portugal - 2011*, INE Website, 2012. URL: http://www.ine.pt/ngt_server/attachfileu.jsp?look_parentBoui=148313382&att_display=n&att_download=y.
3. Rádio Televisão Portuguesa (RTP): *RTP Acessibilidades*, RTP Website, 2013. URL: <http://www.rtp.pt/wportal/acessibilidades/audiodescricao.php>.
4. Entidade Reguladora para a Comunicação Social (ERC): *Deliberação 5/OUT-TV/2009*, ERC Website, 2009. URL: <http://www.erc.pt/download/YToyOntzOjg6ImZpY2hlaXJvIjtzOjM5OiJtZWRpYS9kZWNPc29lcY9vYmplY3RvX29mZmxpbmUvMTM3Ni5wZGYiO3M6NjoidGl0dWxvIjtzOjIzOiJkZWxpYmVvYWNhby01b3V0LXR2MjAwOSI7fQ==/deliberacao-5out-tv2009>.
5. Quico, C. (2005): *Acessibilidade e Televisão Digital e Interactiva: o caso particular do serviço de Áudio-Descrição destinado a pessoas invisuais ou com deficiências visuais graves*, in Estratégias de Produção em Novos Media, Edição COFAC/ Universidade Lusófona de Humanidades e Tecnologias.
6. ZON Multimédia (ZON): *Responsabilidade Social*, Portal Zon, 2010. URL: <http://www.zonold.com/Cientes/DetailClientes.aspx?detail=XzU495>.
7. Sky: *If you have a visual impairment*, Sky Website, 2009. URL: <http://accessibility.sky.com/get-the-most-from-sky/sky-tv/if-you-have-visual-impairment>.
8. Royal National Institute of Blind People (RNIB): *Goodmans Smart Talk Freeview set top box*, RNIB Website, 2010. URL: <http://www.rnib.org.uk/Shop/Product%20instructions/TV0401.doc>.
9. Royal National Institute of Blind People (RNIB): *Smart Talk Freeview digital box from Goodmans*, RNIB Website, 2010. URL: <http://www.rnib.org.uk/shop/Pages/ProductDetails.aspx?productID=tv0401>.
10. Vimeo: *RNIB Smart Talk Freeview Box*, Vimeo Website, 2013. URL: <http://vimeo.com/58373608>.
11. Sky: *Sky Talker*, Sky Website, 2011. URL: <http://accessibility.sky.com/news/sky-talker>.
12. Granadino, R e Cendón, J. (2012): *IDTVOS: An INTECO Open Innovation Success Case*, in C. de Pablos Heredero, & D. López (Eds.), *Open Innovation in Firms and Public Administrations: Technologies for Value Creation* (pp. 275-289), Hershey, PA: Information Science Reference.
13. British Broadcasting Corporation (BBC): *BBC iPlayer TV – Audio Described*, BBC Website, 2013. URL: <http://www.bbc.co.uk/iplayer/tv/categories/audiodescribed>.
14. Glaser, B. e Strauss, A. (1967): *The discovery of Grounded Theory: strategies for qualitative research*, Aldine: Chicago.
15. Instituto de Oftalmologia Dr. Gama Pinto (IOGP) : *IOGP*, IOGP Website, 2013. URL: <http://www.institutogamapinto.com>.